[Tunbridge Castle.]

RAMBLES FROM RAILWAYS.

Penshurst to Tunbridge.

Though the road between these two places presents little of interest either to the antiquarian or the more general observer, as regards the solitary village or the not very numerous mansions that we pass or obtain a glimpse of by the way, the walk is delightful from the variety and beauty of the scenery. As we ascend the first hill encountered after leaving Penshurst—where some exceedingly pretty almshouses have been erected in the Tudor style (partly at the expense of the parish, and partly at that of Sir John Sydney)—and turn back, we have a charming view of the castle and church of the Sidneys, embowered but not hidden in the woods. A turn of the road presently shuts out that view: we ascend a little higher, and in a meadow on the left, a circle of trees, with a low hedge, apparently running round its base, attracts the eye, and, in answer to our question, a passing countryman tells us that that is Gamage's Bower, words that in this neighbourhood seem to be as mystical and important as Sir Philip Sidney's oak and Saccharissa's grove; why, we cannot discover. "Barbara Gamage, Countess of Leicester," of whom there are two portraits at Penshurst, one by M. Garrard, representing her with six of her children, dated 1596, appears to be the lady referred to. Presently fresh changes take place: the thick hedges, sometimes swelling into dense plantations, open now on the right to reveal extensive prospects, then suddenly close again; a little farther on, and a similar process takes places on the left; whilst, at intervals, green lanes dive down suddenly from the road, looking so tempting and full of promise, that one can hardly resist the impulse of accompanying them into the depths of the beautiful valleys on either side to which they lead. The character of these plantations is, to a stranger's eye, remarkable—they are so full of young, very tall, and very slender shoots; which, continuing at intervals in masses for miles together, suggests the idea of their being grown for some peculiar purpose. What that is, an opportunity soon occurs of our determining, as we pass a field densely covered with these poles and the beautiful twining foliage of the plant they support, the hop, which now forms so important an item in the agricultural prosperity of Kent, but which, in 1528, or four years after its introduction, was petitioned against to parliament as a "wicked weed." A large group of old withered-looking trees, spreading their leafless lower branches in the most fantastic directions through the dense shade formed by their heads on the right, would form a fine study for the pictorial artist; and a striking contrast to the open, airy, sunny landscape which breaks upon us soon after at the junction of the two roads from Tunbridge. In the middle distance a green hill comes regularly sloping down from the right towards the centre of the picture, its outline finely relieved at first against the horizon, then against the distant hills, which, as it leaves entirely open the view towards the left of the picture, presents us with the delightfully situated villages of Mereworth, the seat of Lord le Despencer, and East Peckham, with its white church-spire, where the famous knights of St. John of Jerusalem once had a preceptory, or residence for a few members of the Order. We must pause once more as we reach the summit of the hill just mentioned, where we have the valley below us with its patches of golden heath, and white cottages gleaming here and there, extending far away, both right and left, a range of hills as high as that on which we stand opposite, whilst midway, hovering over the valley, a flight of rooks moves slowly and drowsily along, silent as everything else around them. Even the railway train that now comes into sight on the extreme left, seems to have lost its usually turbulent characteristics of progress, as it passes through this sweet valley, and glides, to our ear at least as we stand upon this eminence, smoothly and noiselessly along, till it is lost, in

a few minutes, in the picturesque mass of houses reposing toward the extreme right of the valley, and which we subsequently find is the place of our own destination, Tunbridge.

This is one of the places seldom visited expressly for its attractions, and yet, when visited, exceedingly interesting. Its youthful sister, a few miles off, Tunbridge Wells, has effectually eclipsed it, though but a mere upstart of a couple of centuries or so, whilst Tunbridge, when it would refer to its genealogy, must go back to the Conqueror certainly, and there is no saying how much further still. Tunbridge is a clean-looking, wide-streeted, and not altogether unpicturesque-looking place, were it only for its situation, on the Medway, here divided into several arms, and its numerous bridges; but it is not to these features we refer, nor to its large and handsome, but certainly not altogether architecturally homogeneous church (being of different styles), nor its richly endowed free-school, town-hall, or market-house, nor even to its priory ruins, now turned into a barn, but of its once famous castle, under protection of which the town first rose into wealth and repute, and which, from the extent of its remains and the existing records of its history, will well repay the attention of visitors. The remains are allowed to be shown by the proprietor, whose residence adjoins, four days in the week, namely, Tuesday to Friday. The castle was, of course, situated close to the river, so as to command its approach; near one of the bridges, and not far from the market-place, accordingly we find it. As we approach, we perceive that what is left of the castle comprises an entrance gateway, flanked by strong round towers, the whole tolerably perfect, and a high mound of earth, on which stood the keep or stronghold, and within which mound many apartments still exist. We ascend to the top of the latter by means of a winding path. Traces of the moat and walls, which enclosed in all about six acres, are also discoverable. Not content with the acknowledged antiquity of the castle, which was built by Richard FitzGilbert or Richard of Tunbridge, afterwards Earl of Clare, during the reign of the Conqueror, some of the very zealous local antiquarians will be content with no less than a Roman origin, pointing to a portion of the remains built with tile as a proof. The manor, it appears, was first given by the Conqueror to the church as a part of the see of Canterbury; but Odo, bishop of Bayeux, his half-brother, taking a fancy to it, seized and kept possession, in defiance of all remonstrances, till Lanfranc was appointed to the archbishopric, who speedily set to work in earnest to restore to the church all her past possessions in their integrity. Having complained to William, the latter, knowing by experience the avaricious character of his brother, did not hesitate to grant a formal and public trial, which took place, under circumstances of great solemnity, at Aylesford, in this county, before commissioners of distinction and a jury of the most respectable persons from the different counties where Odo had been exhibiting his rapacity at the expense of the see, in the same manner as at Tunbridge and other parts of Kent. Lanfranc's spirit and eloquence—for he pleaded his own cause—gave him a complete victory: twenty-three manors were restored to the church, Tunbridge forming the only exception; for as this had been given by Odo to his kinsman Richard de Clare, Lanfranc, at the intercession of the king, agreed to receive, in lieu of it, the castle and country of Brionne in Normandy, which belonged to that young nobleman. An interesting evidence of the simplicity of the times has been preserved in connection with this exchange. The castle of Brionne was measured by a string carried round it, which was brought over to England, and used to mark out an equal space of ground at Tunbridge, including the town, and this was the space given to the earl. Thus settled in his English possessions, the latter began the erection of his castle, which he made as strong as the skill and appliances of the time would admit. And many a stout struggle was to test that strength in subsequent periods. Richard himself was on the point of abiding a siege after the death of the Conqueror, through his espousal of the interests of Robert, instead of those of Rufus; but when the latter appeared before the castle with a large army, he submitted, swore fealty and observed his oath faithfully after. The life of the founder of the castle was in many respects a troubled one. Following Rufus to Normandy, in 1093, he was taken prisoner by the forces of the man whom he had before supported, Robert, and kept in confinement till the peace between the two brothers, in 1096, when Rufus obtained, for a sum of money, advanced for the purposes of a crusade, the dukedom of Normandy, in addition to the undisturbed and unquestioned possession of the kingdom of England. De Clare was then liberated, and returned to his home, where, after some years of peace, he went out to fight the Welsh during the reign of Stephen, and fell—an old man—at the battle of Abergavenny.

During his captivity his son Gilbert appears to have been in possession of the castle, and to have engaged in schemes that, but for a change of thought or feeling on his part at a critical moment, might have materially affected the succession to the throne if successful, or his father's power over his own possessions if they failed. A great conspiracy was formed against Rufus by the northern barons, under the management of Mowbray, earl of Northumberland, in which Gilbert joined. On the breaking out of hostilities, Rufus, marching against the insurgents, took Newcastle, after a two months' siege; and was pushing forward to Bamborough Castle to attack Mowbray, when a communication reached him that was in all probability the means of saving him his crown, if not his life also. Mowbray had placed with great secrecy a body of troops in a defile through which the king was to pass, and where defence from an unexpected attack was almost impossible. Gilbert, touched, it is said, by the remembrance of former favours, found means to inform Rufus of his danger, which was thus avoided. In the following reign, however, we find him again in arms against his sovereign, and defending his castle here, though unsuccessfully, against the forces of Henry I. On account of his father's services and his consanguinity, the king did not, as might have been expected, permanently deprive him of his possessions; which, after his death, descended to his son Richard, the first earl of Hereford, who founded the priory adjoining: the famous Strongbow, who so greatly aided in the conquest of Ireland in the reign of Henry II., was a nephew of this nobleman. During the civil wars of the reign of John, Gilbert, a lineal descendant of the man we have mentioned, and first earl of Gloucester of this family, was the possessor of Tunbridge Castle; which, in consequence of his devotion to the patriot cause, had then to endure another siege at the hands of Fowkes de Brent, the "Falco without bowels," a mercenary follower of John's, whom the people of England had especial reason to dread, and who succeeded in taking possession of it. The earl himself was subsequently taken prisoner at the battle of Lincoln by his father-in-law, the earl of Pembroke, but released on the general settlement of the affairs of the kingdom, which then took place through the entire defeat of the French prince whom the barons had called in to their assistance.

In the incidents thus slightly referred to, including little more than a century of time, we see the chequered kind of life led by the owners of these old

feudal castles—now attacking—now being attacked; one day absolute masters of the lives and fortunes of all within their reach, the next themselves the most helpless of the dependents of their enemies. Of peace, except as a mere necessity for the development of fresh strength to carry on war, they evidently had no idea: if the sovereign did not give them good reasons for fighting—a case of most unfrequent occurrence in the early period of our history—they were content with bad ones; or, if they could do nothing else, they could, as a last resource, fight with each other. Such being the general tenor of the history of our old castles, and especially of the more famous ones, where strength of fortification and importance of local position were added to high rank and great personal influence on the part of the owner, as at Tunbridge, it were an almost endless task to trace that history step by step downwards; we shall therefore merely refer to one or two other interesting matters connected with it during the war between Henry III. and the barons under De Montfort, when the castle was besieged and taken by Prince (afterwards King) Edward, the garrison having previously burnt the town. Gilbert the Red was then the possessor, the nobleman who, without qualities of any remarkable kind, exercised a powerful influence on a remarkable period. This is the Earl of Gloucester, who held so conspicuous a position among the barons headed by De Montfort; and who, at the battle of Lewes, when the king and the prince were taken prisoners, himself added a third to their number, the King of the Romans; but who subsequently, influenced either by suspicions of the integrity of De Montfort, or, what is much more probable, by a miserable jealousy of his power and popularity, reconciled himself to the king, and procured the escape of the prince, who soon after met De Montfort in arms at Evesham, and utterly destroyed him and all the leading men of what may be called the national party of the time. In consequence of these services Gloucester and Edward became greatly attached: the latter, on his return from the Holy Land to take possession of the throne, was entertained with all his retinue most nobly for some days at the castle; and not long after he gave his consent to the earl's marriage with his own daughter, Joan of Arc, as she was called; Tunbridge and all the earl's estates being, however, at the same time settled upon her and her offspring. The lady's history does not end here: Gilbert died in 1295, and some time after his widow formed a romantic attachment to a plain country gentleman, without rank or influence, called Ralph de Monthermer, or Mortimer, married him, and sent him up to Edward to declare the marriage and receive the honour of knighthood. Though Edward might have discovered something of his own spirit in this, he was so highly indignant at the affair, that he threw the husband into prison and took away all the wife's estates. The conclusion exhibits the iron-hearted warrior and most unscrupulous sovereign in an agreeable light. The bishop of Durham interceded for the princess, and succeeded in obtaining Edward's consent to see her, when forgiveness was soon granted: the rest was easy; her husband was freed; she was permitted to live with him. At last the king admitted him to his presence, when, it is said, he became so much attached to him, as to love him as his own son. Edward summoned him to parliament after the reconciliation by the title of Earl of Gloucester and Hertford, during the minority of the deceased earl's son, and subsequently by the title of Lord Monthermer. From this marriage the Duke of Manchester and the Earls of Sandwich, Halifax, and other noblemen have their origin.

The estate came into the possession of the crown on the attainder of the Duke of Buckingham, "poor Edward Bohun," during the reign of Henry VIII.; and having been subsequently given by Elizabeth to Lord Hunsdon, her kinsman, it ultimately passed into private hands, and was allowed to sink gradually into its present state of ruin.

WIRE-ROPES.

The use of iron-wire as a material for ropes is not one of the least remarkable applications of mechanical science which recent years have produced. The use of iron in bars has been known from early ages; but the combination of small wires, twisted and interlaced among each other, is quite a novel method. In the Supplement for November last the general construction of ropes, so far as the use of hempen-fibres is concerned, was treated on; and it may not be uninteresting to add a few details here concerning wire-ropes.

At the Newcastle Meeting of the British Association, Count Augustus Breunner made a communication on the use of wire-ropes in the Harz mines of Germany. About seven years before that period, ropes made of twisted iron-wire had been introduced in place of the flat hempen-ropes previously employed. Subsequently they have been adopted throughout the mines of Hungary and most of those in the Austrian dominions, to the almost total exclusion of hempen-ropes. These iron-ropes were described as being of equal strength with a hempen-rope of four times the weight. One had been in use upwards of two years without any sensible wear, whereas a flat hempen-rope performing similar work would not have lasted much more than a single year. The diameter of the largest wire-rope in ordinary use in the deepest Austrian mines is one inch and a half. The rope is composed of iron-wires, each two lines ($\frac{2}{12}$ of an inch) in diameter: five of these are braided together into strands, and three of these are twisted tightly into a rope. The strength of these ropes is little less than that of a solid iron-bar of the same diameter. The rope on leaving the shaft requires to be received on a cylinder not less than eight feet in diameter, and is kept well coated with tar. In one instance adduced, there is a saving of about one-third of the former power; for four horses with the wire-rope are doing the same work as six horses with a flat rope.

Wire-rope has been used lately as a means of drawing railway carriages, when a fixed instead of a locomotive engine is employed. Those who may have travelled along the Blackwall Railway will have had an opportunity of witnessing the use of wire-rope in this way; iron-wire having been introduced a year or two ago, instead of the hempen-ropes formerly used. A wire-rope was sent from England to Belgium, last year, for the use of one of the Belgian railways, measuring five thousand three hundred yards, and weighing twelve tons.

As a material for suspension-bridges, iron-wire has been found to constitute a most valuable acquisition. In the year 1834 was completed, by M. Challey of Lyon, a wire suspension-bridge over the river Sarine, at Freyburg in Switzerland, of which we have given a detailed account, with engravings, in Nos. 279 and 280.

A remarkable application of wire-rope is in the formation of rigging for ships. Readers of the public journals may have frequently seen announcements relating to this matter within the last year or two. Captain Basil Hall, in his additions to Professor Robison's article 'Seamanship,' in the new edition of the 'Encyclopædia Britannica,' after speaking of the use of iron-chains for cables, slings, top-sail sheets, bobstays, and other parts of a ship's fittings, observes:—"Attempts are now making, and we feel convinced that they will ere long succeed, to introduce iron-*wire*

rigging, which we consider as stronger and better than chain, because less dependent on the accidental quality and careless manufacture of a single part." Further on he remarks: "We do not think wire will answer for running-rope; but for standing-rigging it may, we conceive, be most usefully substituted for hemp." In the evidence given in connection with a trial at Liverpool last year, it was stated that the Great Liverpool, a steam-ship of 1400 tons burden, had been fitted up with wire standing-rigging; as had likewise several other vessels. Mr. Shaw, marine manager to the Oriental and the City of Dublin Steam-Packet Companies, has introduced wire-rigging into the vessels of the Companies; and he states the good qualities of this invention to consist in lightness, security, strength, and small resistance to the wind. Captain Bevis, government superintendent of mails at Liverpool, has stated that upwards of twenty government vessels have been fitted up with the wire-rigging, and the Great Britain, the enormous steam-vessel, at the launch of which Prince Albert lately attended, has all her standing-rigging of wire. Respecting the application of wire to this purpose, the following curious calculations have been made:—"The weight of standing-rigging now fitted and afloat in the Navy is about 7000 tons; and taking the price of hempen-rope at 46*l.* per ton, the value of a first outfit for the whole of the navy will be 322,000*l.*; upon which, by using the wire-rope for the same purpose, a saving would be effected of 107,333*l.*, without taking into consideration the more than triple time that wire-rope will last. It may also be observed, that the wire-rope only exposes two-fifths of the surface to the wind, thus rendering ships rigged with wire to those of hemp less leewardly. It appears that 2303 lbs. of hempen-ropes thus applied expose a surface of 126½ square feet to the wind; whereas the wire-rope, possessing strength as 80½ wire is to 63½ hemp, exposes only 51½ square feet: and as the whole surface of hempen standing-rigging now fitted in the navy exposes (according to the above calculation) 860,000 square feet, whereas the wire-rope has only one of 344,000 square feet—leaving a difference in favour of wire-rope of 529,112 square feet; and allowing the mean force of the wind to be 1½ lb. upon the square foot; the power saved on a leeway would be equal to about 4000 horse-power, or equal to the canvas of more than the whole of the sails of twenty-four frigates; and the displacement saved would be about 3500 tons, which would be equal to about 700 horse-power—making a saving in all of 4700 horse-power." Many of these calculations obviously require the test of long experience to determine their validity. It is also worthy of remark that the recent researches of Mr. Snow Harris concerning lightning storms has rendered it a point of serious importance how far the use of metal in the rigging of a ship may affect its safety during a storm.

The late Mr. Telford made many experiments to determine the strength of iron-wire, as shown in the power of resisting fracture. He set up two vertical posts, to one of which he attached one end of the piece of wire to be experimented on, and allowed the wire to pass over the other, then over an inclined post, and, lastly, to terminate in a weight. Besides the weight at one end, four other weights were attached to the wire; one midway between the two vertical posts, and one equidistant on either side of the centre. In one experiment the specimen of wire was $\frac{1}{10}$ths of an inch diameter, the props or posts were one hundred feet apart; and the wire required a weight of more than 530 lbs. before it broke. In another experiment the wire was $\frac{1}{10}$th of an inch diameter, the props were one hundred feet apart, and the wire broke with 738 lbs. weight. Many similar experiments were made, having for their object the determination of the strength of iron-wire under a variety of different circumstances.

In some of the recent inventions respecting the manufacture of wire-rope, the wires are formed into a twisted group before being applied to practical purposes; whereas in others the wires are laid parallel and bound together without twisting. In Mr. Smith's patent, of 1835, a description is given of the mode of constructing the shrouds and stays of a ship with wires. Pieces of wire, all of equal length, are taken, grouped together, and heated at one end in a furnace to a white or welding heat. This heated end is then passed through an opening connected with some of the mechanism of a ship, and beaten up so as to rivet the wires firmly in their place. This plan, and a plan of riveting to various pieces of iron and wood-work, constitute the modes of constructing the rope, the wires not being actually formed into a rope-like group until they are actually attached to the mechanism which keeps them together. In order to preserve the wires from corrosion or oxidation, they are coated or varnished with a solution of caoutchouc, oil, and asphaltum, or some other anti-corrosive composition; and the whole rope or combination of wires required for one shroud or stay is bound round with cloth or cordage previously saturated with the solution. In a patent taken out in the following year, Mr. Smith extends the principle to other objects. He proposes by this patent to group iron wires together, and to combine and secure them by interweaving hempen yarn among them, or by binding them with string or hempen yarn, or by joining them side by side in the manner of flat ropes, or by coating them with strong canvas, and sewing these casings of canvas together. One form of proceeding is thus described. A proper number of lengths of wire are laid parallel, and coated with an anti-corrosive caoutchouc solution. The wires are then slightly twisted into a strand, so as just to hold together, and to squeeze out the superfluous solution. These strands are then combined into a rope by any one of the methods above alluded to; the hempen or woven material introduced being in all cases previously saturated with the preservative solution.

In Mr. Newall's patent, of 1841, the wire-rope is formed by 'laying' or twisting wires round a central core to form a strand, and by twisting strands round a core to form a rope. The core may be of wire, hemp-cord, spun yarn, a filament of cotton, or a strip of leather. The combination of the wires into a strand is effected by rather a complicated assemblage of machinery, in some degree combining the character of the machines for making hempen ropes and of those used in spinning cotton.

In the same year Mr. Heimann took out a patent for wire-ropes composed of six strands laid round a core, each strand being composed of six wires laid round a core; the cores being saturated with a preservative solution before the wires are twisted round them. This, like the former method, is effected by rather complex mechanism. Other contrivances have been brought forward in different quarters; and the system generally has become so far valuable as to lead to inquiries as to the validity of some of the patents, their priority over others, and so forth: a pretty sure test at all times that the invention itself is deemed a valuable one.

Not only has wire been applied, instead of chains, for suspension-bridges, instead of large ropes for mines and inclined planes, and instead of cordage for ships' rigging, but also as a substitute for small string or large thread in the comparatively humble process of sewing boots and shoes. A few years ago M. Sellier, of Paris, secured a patent in France for the right of using brass wire for attaching the upper leather to the welt of boots and shoes. He states that this metallic

thread allows neither moisture nor dust to enter the boot or shoe; and furthermore that it does not 'rip.' The sewing is said to be performed with as much ease as with waxed thread, and as cheaply. As in most similar cases, the inventor is provided with examples to show how long boots and shoes have been known to last when made by this method; but we do not know to what extent the method has been tested, nor whether any English workmen have adopted it.

LOCOMOTION OF ANIMALS.—No. III.

It has been seen that every attitude of any one part of a man in standing, or in bearing a load, requires simultaneous alterations in the posture of the rest of the body; and we now proceed to show that the act of standing erect is dependent on the general structure and figure of the human fabric. The erect attitude, which contributes, amongst many other things, to distinguish man from the lower animals, is chiefly owing to his organization, and not the effect of mere mental development. It is found that animals instinctively adopt that position of the body which enables them to bear their own weight with the least expenditure of muscular labour, and that in all other positions the support of the body becomes irksome: let us now turn our attention to what takes place in the erect posture in man. The position in which the muscular force is least expended is that in which the bones of the skeleton, and all other parts, are poised upon each other at the joints about which they move: the muscles in this case have merely to perform the office of keeping the superincumbent parts exactly balanced. When a man stands erect, with the eyes directed horizontally forwards, or slightly inclined upwards, the centre of gravity of the head lies vertically over the centre of the joint that connects the head with the neck: also, the weight of the body and head is equally supported on the hip-joints; these again, with the thighs, rest on the centres of the knee-joints, and these on the elastic arches formed by the bones of the foot which are placed on the ground. Thus, in *Fig.* 1 it will be seen that the vertical line *x*, *y*, passes through all the points just enumerated; and, whilst the body is erect, there is required only sufficient muscular power to keep it balanced on the joints, and the joints from bending. Now, to show that the several parts are most easily supported in the erect position, let us see what happens when the body is horizontal. Take the head, for example. The centre of gravity of the head G (*Fig.* 2), instead of lying vertically above the joint of the neck *g*, as when erect, is distant from it by the length of the line G *g*, so that the muscles which keep the head in the horizontal position have to support it with a mechanical disadvantage at the end of a lever G *g*; and it will be found that it cannot be sustained in that position, even for a short period, without great fatigue, which is not felt in the erect posture. It will also be observed that the eyes would be directed towards the ground, so that a man could not look horizontally forwards without difficulty, nor vertically upwards at all, both of which actions are essentially necessary to the pursuits and habits of the human race. In the lower animals the case is quite different; for, if we take the horse as an example, we find that the centre of gravity of the head is brought nearer the joint uniting the head with the neck in the horizontal than in the erect position, as will be seen in *Fig.* 3, where G and *g* are the centre of gravity of the head, and joint of the neck, as before; *a* G is a horizontal, and *a g* a vertical line. In the natural position the weight of the head acts at the end of the lever *a* G; but, if the animal were standing erect on its hind-legs, this weight would act at the extremity of the lever *a g*, which is longer than *a* G, and, consequently, more force would then be necessarily expended in supporting the head. Also, from the position of the eyes in the head, the horse would look directly upwards, and could not direct them to the ground. These considerations alone are sufficient to enable us to come to the conclusion that man is not organized to move as a quadruped, nor quadrupeds as man; and, moreover, in the posture of the quadruped, the whole sole of the human foot would not reach the ground, but the toes only; and he would become a digitigrade, instead of being, as he is now, a plantigrade animal. In the position of a quadruped, also, if the hands and arms were employed to contribute to the support of the head and trunk, they would no longer be free to perform all those various offices to which these organs are manifestly adapted.

Fig. 1.

Fig. 2.

Fig. 3.

Let us again, in illustration of this subject, turn our attention to the structure of that most beautifully framed organ,—the human hand, and investigate its complex structure, its manifold segments, its numerous joints, its extensive motion, the position of the thumb, the power which it possesses of grasping objects, of twisting upon itself, as in the use of the gimlet, and its sensibility of touch, and let us compare with these wonderful properties the solid mass in which the arms of the horse terminate; a glance will be sufficient to convince us that in man the hands are naturally designed for the several functions which they actually execute, and that their complex mechanism would be quite thrown away, were they simply used for progression; which is the thing we intended to prove. Some naturalists have erroneously imagined that the erect posture of man is not the effect of the organization of his body and limbs, but the result of the development of his mental faculties; that persons have been found moving on their hands and feet when deprived by circumstances of intercourse with their fellow-creatures from childhood; and that children in civilized life, during the first months of their existence, move both on their hands and feet; and, therefore, that the erect posture results from education. The principle, however, which we have already established respecting the position requiring the least expenditure of muscular force, is quite sufficient to refute these erroneous views; and it must be remembered that a person shut out from the rest of mankind is not in his natural condition, neither is infancy the perfect state of the human race.

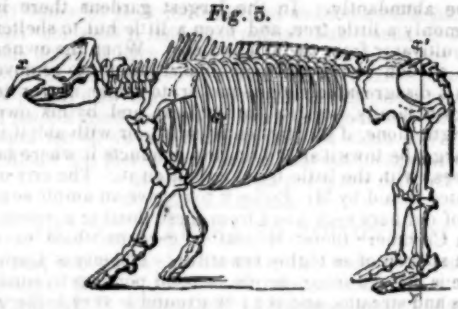
There is a considerable difference in the figure of the vertebral column of man and of the lower animals; in the former it is constructed to bear the greatest weight in the erect, but in the latter in the horizontal position. In man the vertebral column (or, as it is more commonly called, the back-bone) is divided, from the head to the lower part of the loins, into twenty-four joints. Between each bone of the back there is a very elastic substance interposed, of such a nature as to bear the pressure of the bones without injury, to enable them to be twisted and bent upon each other

without coming in contact, and thus to avoid the injury that would result from friction. It might be supposed at first sight that a chain of bones, piled upon each other, separated by so many joints, and capable of moving in various directions, would be a weak and imperfect organ, when considered as a pillar to support the head and body: this, however, is by no means the case; for, independently of its office in upholding the head and trunk, each bone is hollow, so that the vertebral column forms a tube for the passage of the spinal marrow or cord, which it encases, and protects from external violence, in all the varied occupations of life. Destined, then, as the bones of the back are to protect so important an appendage of the brain, and to support the weight of the head and trunk, special care has been taken by the all-wise Creator to construct each bone with sufficient strength for these purposes; we, consequently, find the bones of the neck, which have the least weight to bear, the smallest, and that they gradually increase in size down the back to the loins, where they are the largest. Each bone of the back is bound so strongly by ligaments to the one above and below it, and its figure is so constructed to lock into the adjoining bones, that no common force will disunite them: indeed, so firmly are the bones of the back bound and locked together, that a force sufficient to crush the body of the bone will alone separate them. A fracture of this kind is, accordingly, one of the most serious accidents that can befal a man, and, in fact, death most commonly results from it. The vertebral column is not straight, but curved in three places, as shown in *Fig.* 4. At *a*, the neck, the spinal column lies in front of the vertical line *x y*; at *b*, the back, part of the column supporting the shoulders lies behind the same line; and at *c*, the loins, the column again lies in front of it. Now, it may be imagined by some persons that this curved condition of the back is a defect and a source of weakness, but it is, on the contrary, a condition of security and strength; for, the jars incidental to walking, leaping, and heavy blows, coming vertically on either extremity, are thus transmitted obliquely through the whole column, so that much of their violence is lost. Moreover, it has been found by Euler that an elastic rod, when slightly curved, will bear upon its end a much greater weight than if straight; and if the number of small curves be three, the weight it will sustain will be the square of three, with one added, or 4×4, that is, sixteen times greater than if it were straight. Now, if we may consider it admissible to apply this principle to the human vertebral column in bearing a burden on the head in the erect posture, we shall see that, in this posture, a man is capable of carrying, or rather supporting, such a load as would almost break the back in a prone position.

Fig. 4.

We observe that the bones of the back, or vertebral column, are also curved in the lower animals; but, instead of forming several curves in opposite directions, as in man, it forms one large arc, which is convex upwards, when the spine of the animal is directed horizontally. This form of the bones of the back in quadrupeds is conspicuous in the Ruminantia and Pachydermata; for instance, in the rhinoceros, as seen in *Fig.* 5, the whole of the column lying between *x* and *y* forms one large arch with its concavity directed downwards; and, as each bone which enters into the composition of the arch is bound to the adjacent bones

Fig. 5.



by ligament, or fibrous cord, of great strength, any force or load laid upon the back of the animal, in its natural prone position, by tending to bring that portion of the spine lying between *x* and *y* into a straight line, tightens these cords; and thus the spine itself is capable of bearing as much, or perhaps more weight than the limbs of the animal could carry in its natural position: but, if the load were laid on the top of the spine, instead of across it, on the supposition that the body of the animal assumed an erect posture, the arch of the back would increase, and the spine would be broken by the same load which it would easily bear when laid across it. Here, then, we have another illustration of a quadruped requiring a prone position derived from the constitution of its vertebral column. Independently of this, if we were to examine the relative positions of the joints, we should find that, when a quadruped is placed in an erect posture, a vertical line passing through the centre of gravity of the head and the axis of the joint which unites it to the trunk, does not, and cannot pass through the centre of gravity of the animal, G, and the hip, knee, and ankle joints at the same time, as in man; neither can the horizontal line *x y* be brought to coincide with the vertical line *x' y'*: and, that therefore, the erect position of a quadruped is not that of least expenditure of muscular action, which we maintain is the position natural to every animal in the act of standing.

FLOATING ISLANDS AND GARDENS.

There have been, and yet are, many islands or islets which float in water, and have no solid foundation beneath them. A fact so contrary to our usual experience may seem strange; but there are in most instances the means of forming some idea of their mode of production. A few of the most remarkable may not be unworthy of a slight notice.

The floating islands and gardens of Mexico, though now little regarded, were at one time of great celebrity. When the Mexicans were brought into subjection to the Calhuan and Tepanecan nations, and confined to some small islands in a lake, they ceased for some years to cultivate the land on account of their limited space; but at length necessity and industry taught them to form moveable fields and gardens, which floated on the waters of the lake. They first formed a foundation, or kind of boat, of wicker-work, about eight perches long by three broad, and matted it with water-plants and mud. On these floating foundations, when supplied with manure and mould, they cultivated maize and other useful plants; but afterwards they formed gardens of flowers and odoriferous plants, which were used for the houses of the nobles and for the worship of the gods. Humboldt says that these floating gardens still exist. They are of two sorts: the one mobile, and blown here and there by the wind; the other fixed and united to the shore. Flowers and every sort of garden-herbs are cultivated on them, and

thrive abundantly. In the largest gardens there is commonly a little tree, and even a little hut to shelter the cultivator from the sun and rain. When the owner of a garden wishes to change his situation, to remove from a disagreeable neighbour, or to come nearer to his own family, he gets into a boat, and by his own strength alone, if the garden be small, or with aid if it be large, he tows it after him, and conducts it where he pleases, with the little tree and hut on it. The city of Mexico is said by Mr. Bullock to receive an ample supply of culinary vegetables from these floating gardens.

In Cashmere there are floating gardens which have been spoken of as highly beautiful. The city of Cashmere is divided into different isolated portions by small lakes and streams, and the low ground is very liable to be suddenly flooded. As a means of avoiding the inconveniences to which this state of things would expose gardens cultivated in the usual way, the inhabitants are accustomed to make gardens on little floating islands in the lakes. Moorcroft describes the formation of these gardens to be nearly as follows:—Various aquatic plants, such as reeds, water-lilies, &c., spring from the bottom of the lakes to the surface of the water, and there form a green fringed surface. The boats which traverse the lakes, taking in general the shortest way to their respective places of destination, cut various tracks or paths through the weeds. On the sedgy patches thus left the farmer establishes his melon and cucumber floats, by cutting off the roots of the aquatic plants about two feet under water, so that they lose all connection with the bottom of the lake, but still remain connected in a group. He then presses them together in closer contact, and forms them into beds about two yards in breadth, and of an indefinite length. The heads of the sedge, reeds, and other plants are then cut off and left on the surface of the float, over which is laid a thin coat of mud. This forms a kind of continuous substratum by insinuating itself through the stems of the plants. The float is prevented from being driven about by the wind by driving willow-stakes through it at each end, and which do not prevent it from rising and falling with the rise and fall of the water. When the surface is properly prepared, the farmer introduces into it cucumber and melon plants which he had previously raised under mats, planting them at a distance of two feet apart, after which no further care is required till the fruit is to be gathered. Some of these little garden-islands will bear the weight of a man; but in most cases the farmer rows in a boat to the side of the garden, and there conducts his labours. Moorcroft speaks of the growth of cucumbers and melons on these spots as being singularly luxuriant and successful. Mr. Vigne, while speaking of the appearance of the lakes near the city, says:—"Numerous villages on the edge of the water, surrounded with walnuts and chemars, are taken into the *coup d'œil;* a green causeway which is extended across it is an object of attraction; but we look upon the famed floating-gardens of Kashmir (this name, like most of those relating to oriental subjects, is spelt very differently by different writers), without being able to distinguish them from the green and richly cultivated grounds upon that edge of the water which borders upon the city."

Islands formed of drift-wood are in some respects more remarkable than the floating gardens above described, for they are formed, often on a large scale, by natural causes. Floating islets of matted trees are sometimes seen sailing at the distance of fifty or a hundred miles from the mouth of the Ganges, with living trees standing upon them. The Amazon, the Congo, and the Orinoco present similar phenomena. Spix and Martius relate that during their travels in Brazil they were exposed to great danger while ascending the Amazon in a canoe, from the vast quantity of drift-wood constantly propelled against them by the current; so much so, that their safety depended on the crew being always on the alert to turn aside the trunks of trees with long poles. The tops alone of some trees appeared above water; others had their roots attached to them with so much soil, that they might be compared to floating islets. On these islets the travellers saw numerous animals, strangely mingled in companionship. On one raft were several strange-looking storks, perched by the side of a party of monkeys, who made comical gestures and burst into loud cries on seeing the canoe. On another was seen a number of ducks and divers, sitting near a group of squirrels. Next came down upon the stem of a large rotten cedar-tree an enormous crocodile by the side of a tiger-cat, both animals regarding each other with hostility and mistrust.

Green rafts, composed principally of canes and brushwood, are called 'camelotes' on the river Parana in North America: they are occasionally carried down by inundations, bearing on them pumas, caymans, squirrels, and other quadrupeds, who always appear terror-stricken while on these floating habitations. Four pumas were landed in this manner in one night at Monte Video, to the great alarm of the inhabitants, who found them prowling about the streets in the morning. Captain W. H. Smyth told Mr. Lyell that he had often, when cruising among the Philippine Islands, met floating masses of wood with trees growing upon them: ships were sometimes in imminent peril from these rapidly moving masses being mistaken for islands. Another naval officer relates that while returning from China he encountered near the Moluccas several small islands, covered with mangrove-trees interwoven with underwood. The trees and shrubs retained their verdure, receiving nourishment from a stratum of soil which formed a white beach round the margin of each floating islet, where it was exposed to the washing of the waves and the rays of the sun; this soil having arisen from the earthy sediment left by the water in all rivers and straits where such rafts are likely to be found.

The river Mississippi, from the existence of vast forests near its banks, is liable to be interrupted by the formation of floating islands far more remarkable than any we have yet noticed. One of the largest of these some years ago was called the raft of Atchafalaya, the latter being the name of one arm or branch of the Mississippi. This branch catches a large portion of the timber annually brought down from the northern part of the Mississippi; and the drift trees thus collected, in about thirty-eight years previous to 1816, formed a continuous raft no less than ten miles in length, two hundred and twenty yards wide, and eight feet deep. The whole rose and fell with the water, yet was covered with green bushes and trees, and its surface enlivened in the autumn by a number of beautiful flowers. It went on increasing till about the year 1835, when some of the trees upon it had grown to the height of about sixty feet. Steps were then taken by the State of Louisiana to clear away the whole raft and open the navigation; which was effected, not without great labour, in the space of four years.

Near New Orleans, where the immense body of water from the Mississippi and its tributaries enters the Gulf of Mexico, large log islands are formed in great number, by a process of which the following are the chief steps:—In the early part of the spring, when the 'freshets' or 'floods' occur, they bring along with them millions of trunks of trees, which become entangled or matted together in a kind of gigantic network, several fathoms in depth: they become cemented by earthy deposits, and a rank sort of cane or reed

springs up, which helps to unite them. This fringe of reeds retains the mud brought down the river afterwards; and every year then brings its fresh logs, fresh reeds, and fresh mud, followed by the growth of stunted shrubs.

In the higher parts of the Mississippi these floating islands become fixed encumbrances of a most formidable kind. There are many sudden bends in the river, and the current at these parts often undermines the banks, and plunges thousands of trees at one dash into the river. The greater number of these trees are swept down to the sea, there assisting to build up the log-rafts just alluded to; many are stopped in their progress by islands standing in the way; while some float into the shallow water between these islands and the main, where they grow into rafts several miles in length, and form, along with the mud deposited by the river, the substratum of future land. But some of the largest of the trees, after being cast down from the position in which they grew, get their roots entangled with the bottom of the river, where they remain fixed to the mud. The force of the current naturally gives their tops a tendency downwards, and soon strips them of their leaves and branches. These fixtures, called 'snags,' or 'planters,' are very dangerous to vessels going up the river, since they have their pointed or rugged ends directed obliquely so as to encounter the vessel in its progress, and in such case the bottom of the vessel is extremely liable to be pierced through. These formidable snags sometimes remain so still that they can be detected only by a slight ripple above them, not perceptible to inexperienced eyes; but sometimes they vibrate or rock to and fro, alternately showing their heads above the water and dipping beneath it; a movement which, in the odd language of the West, has earned for them the name of 'sawyers.' To guard against these 'snags' and 'sawyers,' many of the Mississippi steam-boats are provided with a safety arrangement called a 'snag-chamber.' At a distance of twelve or fourteen feet from the stem of the vessel a strong bulkhead is carried across the hold from side to side, as high as the deck and reaching to the keel. This partition, which is formed of stout planks, is caulked and made so effectually watertight, that the foremost end of the vessel is cut off as entirely from the rest of the hold as if it belonged to another boat. If the vessel happen to run against a snag, and a hole be made in her bow under the surface of the water, this chamber merely becomes filled; for the communication being cut off from the rest of the vessel, no further mischief need ensue.

A floating island in Keswick Lake, in Cumberland, has been the theme of much conjecture for many years. From an account of it, by Mr. Otley, published some years ago in the 'Manchester Memoirs,' it appears that the place where the island occasionally makes its appearance is in the south-east corner of the lake, not far from Lowdore, generally about a hundred and fifty yards from the shore, where the lake is from three to six feet in depth. The times of its appearance are irregular and uncertain: it has sometimes been observed in two successive years; at other times with an interval of seven or eight years, and mostly about the termination of a warm dry season. Its figure and extent are also variable; sometimes comprising nearly an acre of ground, and at others only a few perches. It is entirely covered with vegetation: its surface, to the depth of a few inches, is composed of a clayey or earthy matter, apparently deposited by the water; and the rest is a kind of imperfectly formed peat-moss. After an absence of eight years, it emerged on the 20th July, 1808, and increased for a few days till about eighty yards in length. It remained unaltered for some weeks, with its surface about a foot above the level of the water; but it then lowered gradually till the beginning of October, when it sank beneath the surface, and was not seen again till 1813, at which time it rose and remained visible for about six weeks.

Much controversy has arisen respecting the cause of this phenomenon. Some attribute the rising of the earth or peat, or whatever it may be, to the rarefaction of air under it by heat; others thought that a small rill or brook, falling from the mountain opposite the place, might possibly meet with a subterraneous passage, by which it enters the lake unperceived, and reaches to this spot; and that during a dry season its outlet may be so far choked up that on the commencement of rain the confined water may force up this island. Dr. Dalton, in 1815, made an experiment on the island, with a view to determine the nature of the gases which it was frequently known to evolve. He thrust a stick a foot deep into the soil of the island, and out of the hole ascended a mixed gas of nitrogen, carburetted hydrogen, and carbonic acid. Mr. Otley had before given an opinion that the ascent of the island to the surface of the water was due to the presence of a large quantity of gas in the spongy material of which the island is formed; and in reference to this opinion, Dr. Dalton remarks:—"Mr. Otley has, I apprehend, suggested the only plausible cause that can be assigned for the rising and sinking of the island. The generation and temporary adhesion of such immense quantities of elastic fluid must have great influence upon the specific gravity of any mass; and when the mass happens to be nearly of the same specific gravity as water, and immersed in it, it will sink or swim according as the adhering volume of air is less or more.

In Esthwaite Lake, Cumberland, a floating island exists which has conveyed as many as fifteen persons at once across the lake.

Ireland in the Sixteenth Century.—And there is also a certain other island, called Hibernia, and Ireland as well, large and populous. For it measures 600 miles; being not further distant towards the south than thirty-five miles from the island of the English. It possesses towns and cities. But the inhabitants reject political institutions, and other importations, with whatever else pertains to them. And it is no long time since it has been reduced under subjection to the king of England; and from him it receives its administration. . . . The island Hibernia, then, is of a fruitful nature, and yields corn, and furnishes animals of all kinds; and whatever things are in England and Scotland, in none of these is it inferior. But yet they do not pay so much attention to civil polity. As many, indeed, as live in cities and walled towns have something of human polity and administration. But such, on the other hand, as live in forests and bogs are entirely wild and savage; and there remains only the human form whereby they may be distinguished to be men. They are tall fair complexioned, and rather light-haired; wearing much hair on their heads and having a shaggy beard. They go at all seasons without any other clothing than that which covers their loins; and neither heat nor cold annoys or enfeebles them. But they devote themselves to archery, and practice running with excessive endurance, so as frequently to contend in speed with horses and hunting-dogs. And they gird on their thigh a barbaric sword, not very long, and in their left hand they carry certain javelins. And they throw with so good an aim, that their skill in hitting the mark is by many thought to be marvellous. They wear neither covering to their head nor shoes to their feet; are swift of foot, and engaged in battle hand to hand; habituating themselves to feats of desperate courage and hardihood. And as many of them as appear to live in a more civilized manner, having sewed together vestments of linen and hemp of all colours, clothe themselves in garments extending to their feet, and made after a barbaric fashion. And their wives also are accustomed to wear something of the same kind. . . . They feed on everything, and gorge themselves to excess with flesh. They are continually eating milk and butter. And if the king of England need their service, they are able to muster to the number of ten thousand, or even more. And the men being valorous in feats of war, have frequently acquired renown.—*Travels of Nicander.*